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ANALYSIS OF SCATTERING DATA FROM A THIN-SEDIMENT AREA  
FOR THE BOTTOM INTE. (U) SCIENCE APPLICATIONS

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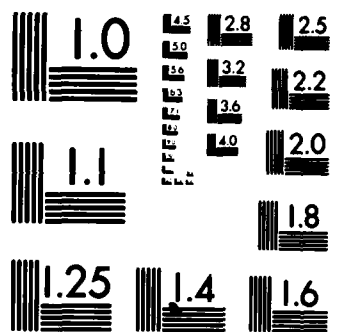
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FINAL REPORT FOR  
CONTRACT N00014-85-C-0209:  
ANALYSIS OF SCATTERING DATA FROM A  
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INTERACTION PROGRAM

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Report SAIC-86/1668

FINAL REPORT FOR CONTRACT N00014-85-C-0209: ANALYSIS OF  
SCATTERING DATA FROM A THIN-SEDIMENT AREA FOR THE BOTTOM  
INTERACTION PROGRAM

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14 April 1986

Final Report for Period 15 February 1985 - 14 February 1986



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14 April 1986

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14 April 1986

**FINAL REPORT FOR CONTRACT N00014-85-C-0209: ANALYSIS  
OF SCATTERING DATA FROM A THIN-SEDIMENT AREA FOR  
THE BOTTOM INTERACTION PROGRAM**

**1. INTRODUCTION**

**1.1 Contract Information.** This document is the final report for Office of Naval Research Contract Number N00014-85-C-0209. The work under this contract was conducted by Science Applications International Corporation (SAIC) during the period from 15 February 1985 through 14 February 1986.

**1.2 Reports.** There are two technical reports submitted under this contract:

- (1) C.W. Spofford, S.R. Moore, E.S. Holmes, and L.B. Dozier, "Angle, Time and Frequency Spreads from a Thin-Sediment Area of the Northeast Pacific Ocean, and (U)", SAIC Report No. SAIC-86/1666, 14 April 1986.
- (2) W.E. Farrell and W.F. Monet, "Shallow Sub-bottom Reflectors in the N.E. Pacific - Distribution and Physical Properties", SAIC Report No. SAIC-86/1667, 14 April 1986.

**2. TASK: ANALYSIS OF SCATTERING DATA FROM A THIN-SEDIMENT AREA**

**2.1 Statement of Work.** The Contractor shall analyze scattering data from a thin-sediment area for the Navy's Acoustic Bottom Interaction Program. This work shall be conducted in general accordance with the Contractor's Proposal Number 1-423-71-850-08 entitled "Analysis of Scattering Data from a Thin-Sediment Area," dated 8 October 1984, of which page 3-1 is incorporated herein by reference.

That page reads as follows: Science Applications International Corporation will analyze available horizontal and vertical array data acquired during Overbid Leo Leg 4 to estimate angle and time spreads versus grazing angle and number of bounces of bottom-bounce signals in thin-sediment areas. Comparisons with existing theories will be made to evaluate their ability to model these phenomena using independent environmental data. Should these theories be inadequate, empirical scattering cross sections will be derived to support systems engineering calculations.



**2.2 Data Analysis.** SAIC processed the available Over-bid Leo Leg 4 data for horizontal angle spreads, frequency spreads, and time spreads. These spreads were quantified and displayed in contour plots and three-dimensional surface plots. Results are presented in Technical Report (1) listed above. For all of the available data, the experimental geometry was such that at least four (or possibly three in some cases) bottom bounces had occurred.

**2.3 Comparisons with Existing Theories.** A theory of single-bounce angle spreads (assuming geometric scattering off slopes) recently developed at SAIC by Zabai, Brill, and Collins (J. Acoust. Soc. Am. 79, 673-680 (1986)) was used for comparison with angle spreads found in the data. This theory could not account for the observed angle spreads under any reasonable hypothesis of how the one-bounce spread should accumulate over four bounces.

A simple single-scatter model, where the dependence on angle of scatter was a normalized Gaussian distribution, was surprisingly effective in matching the time and angle spreads observed in some of the data.

**2.4 Empirical Scattering Cross Sections.** It was found that empirically, time spreads found in this data were not unlike spreads that could be estimated from other data taken in similar areas. Together, these data sets give us a consistent estimate of time spreads in thin-sediment areas.

**2.5 Geologic and Geophysical Data.** For bounds on seafloor roughness needed for input to the models discussed above, and for more insight generally into the physical mechanisms at work in thin-sediment areas, SAIC prepared a brief synopsis of geologic and geophysical data collected in such areas between the Mendocino Fracture Zone (38° N latitude) and the Murray Fracture Zone (30° N latitude), and between 128° and 160° W longitude. This synopsis has been delivered as Technical Report (2) listed above. The focus of this report is to provide a physical model of sub-bottom reflectors, including volcanic ash, chert and basaltic basement, in order to help explain the acoustic signature of paths which propagate through seafloor sediments and interact with these reflectors.

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